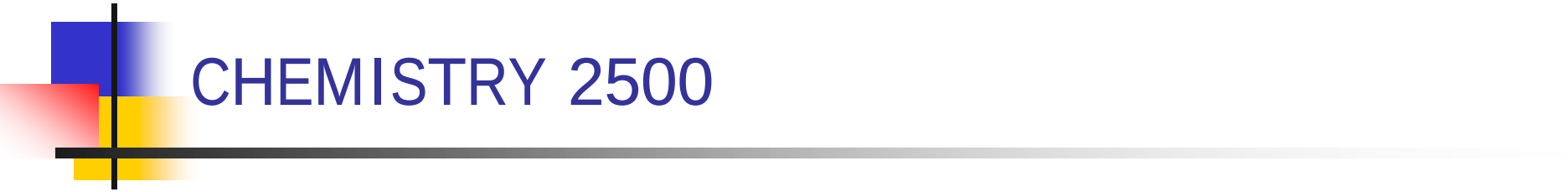
Please note that we reviewed drawing resonance structures and calculating formal charge in the Topic 1 notes!
Ogilvie covers those topics in Chapter 5.



CHEMISTRY 2500

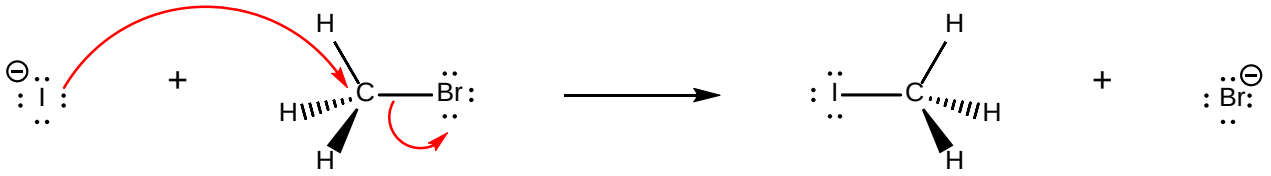
Topic #5: Organic Reaction Mechanisms

Spring 2020

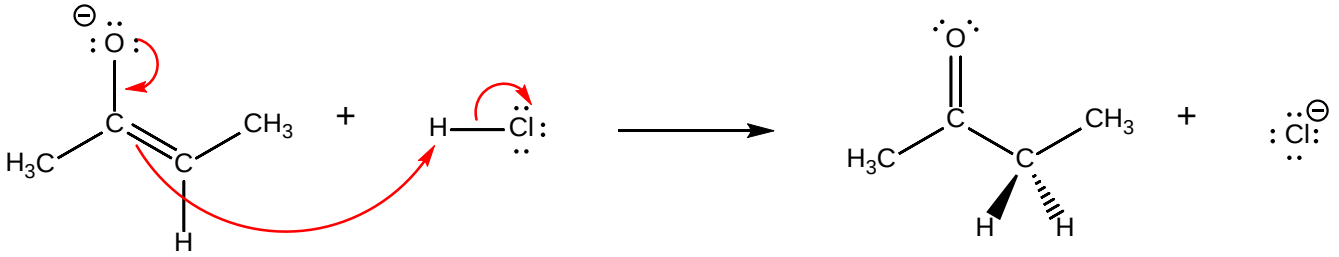
Dr. Susan Findlay

Reaction Mechanisms and Curved Arrows

- A reaction mechanism is a series of step(s) describing how a reaction proceeds. The movement of electrons in each step are shown using arrows commonly referred to as “curved arrows”:

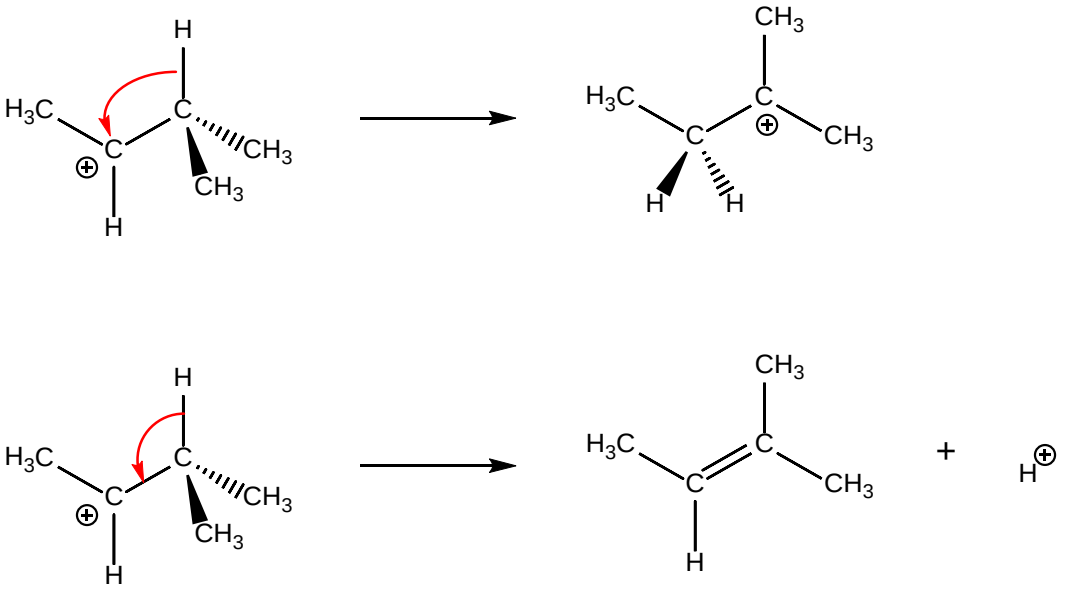


- Each step in a reaction mechanism is referred to as an **elementary process** and can be imagined to proceed as the result of one collision between molecules (or as a single step involving only one molecule). As such, the electrons will appear to “flow” from one part of the system to another:



Reaction Mechanisms and Curved Arrows

- When drawing curved arrows, be careful whether they are pointing at an atom (indicating formation of a new bond to that atom where there was not previously a bond) or pointing at a bond (indicating that the order of that bond increases by 1).



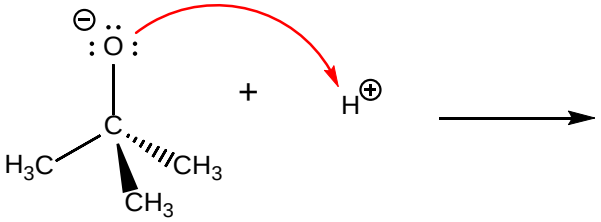
Things That Are Essential to Remember!!!

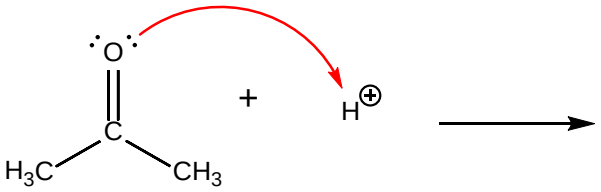
- CURVED ARROWS **ALWAYS** SHOW MOVEMENT OF **ELECTRONS**. NEVER ATOMS OR IONS!
- Electrons flow in **ONE DIRECTION** – from electron-rich to electron-poor; from base to acid; from **NUCLEOPHILE TO ELECTROPHILE**.
- Don't push multiple arrows into the same atom. One in; one out. (Often just "one in" or "one out".)
- Each arrow represents the movement of a **PAIR*** of electrons.
- When pushing electrons, remember that period 2 elements (including C, N and O) can **NEVER** have more than 8 electrons!!!

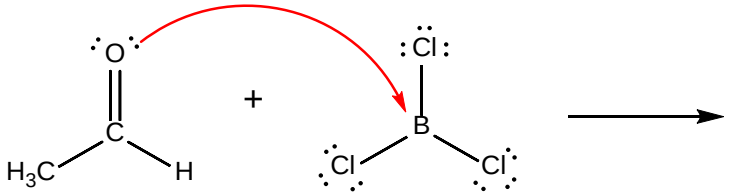
* To show movement of single electrons, chemists use half-arrows.

Curved Arrows and Formal Charge

- Consider an elementary step in which a single curved arrow shows the formation of one bond. What happens to the formal charge on the atoms at each end of the arrow?

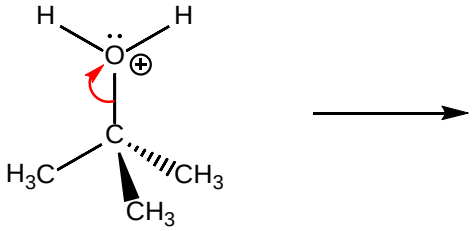


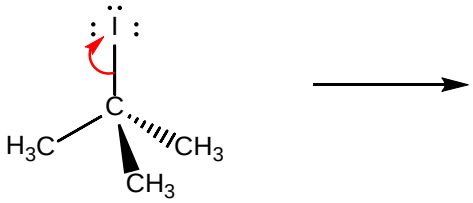


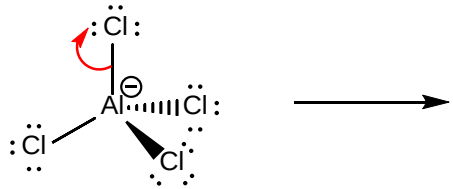


Curved Arrows and Formal Charge

- Consider an elementary step in which a single curved arrow shows the breaking of one bond. What happens to the formal charge on the atoms at each end of the arrow?

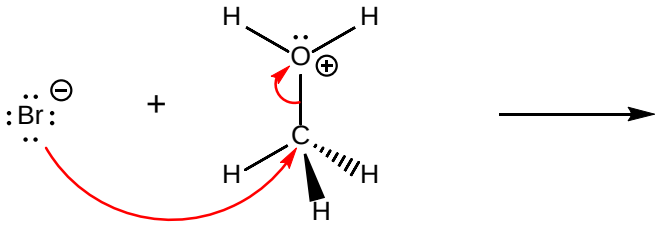


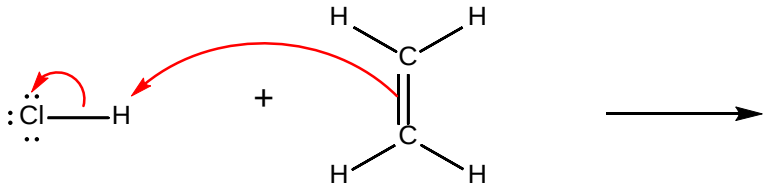




Curved Arrows and Intermolecular Reactions

- Many elementary steps involve the movement of more than one pair of electrons. Use the curved arrows to identify the product(s) of each elementary step below.

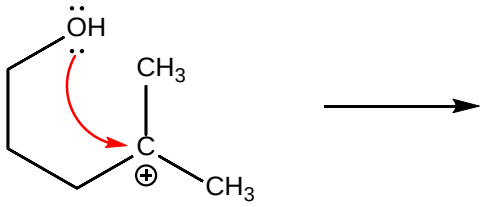


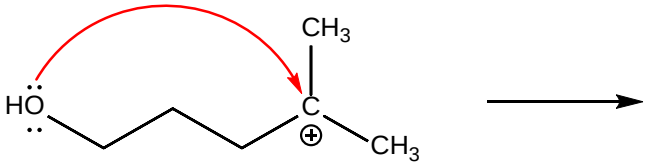


- These are **inter**molecular reactions – reactions "between different molecules".

Curved Arrows and Intramolecular Reactions

- In some reactions, the atom donating an electron pair and the atom accepting it are in the same molecule. These are **<u>intra</u>molecular** reactions – reactions "within a molecule".
- Use the curved arrows to identify the product(s) of each elementary step below.

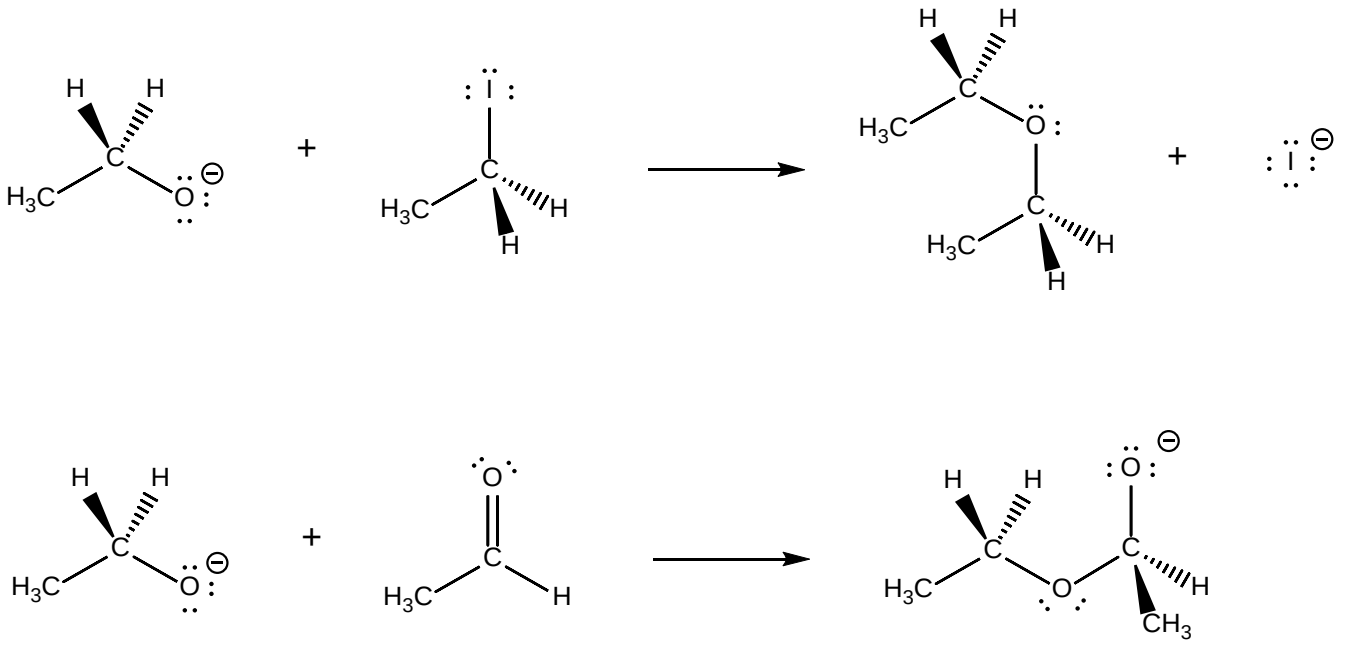




Notice anything about the two examples above?

Drawing Curved Arrows

- The reactants and products are shown for the following elementary steps. Add the curved arrows to show the movement of electrons.



Hint: Start by identifying which electrons move…